

**Notice of Allowability**

Application No.

10/084,563

Applicant(s)

LOPATIN ET AL.

Examiner

Art Unit

Hsien-Ming Lee

2823

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 8/12/03.
2. ☒ The allowed claim(s) is/are 1-4, 6-14 and 16-20.
3. ☒ The drawings filed on 2/26/02 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  - a) ☐ All b) ☐ Some\* c) ☐ None of the:
    1. ☐ Certified copies of the priority documents have been received.
    2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
    3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).
- \* Certified copies not received: \_\_\_\_\_.
5. ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
  - (a) ☐ The translation of the foreign language provisional application has been received.
6. ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application. **THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

7. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
8. ☐ CORRECTED DRAWINGS must be submitted.
  - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
    - 1) ☐ hereto or 2) ☐ to Paper No. \_\_\_\_\_.
  - (b) ☐ including changes required by the proposed drawing correction filed \_\_\_\_\_, which has been approved by the Examiner.
  - (c) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No. \_\_\_\_\_.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet.

9. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

- 1 ☒ Notice of References Cited (PTO-892)
- 3 ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 5 ☐ Information Disclosure Statements (PTO-1449), Paper No. \_\_\_\_\_.
- 7 ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
- 2 ☐ Notice of Informal Patent Application (PTO-152)
- 4 ☐ Interview Summary (PTO-413), Paper No. \_\_\_\_\_.
- 6 ☐ Examiner's Amendment/Comment
- 8 ☒ Examiner's Statement of Reasons for Allowance
- 9 ☐ Other

## DETAILED ACTION

### *Remarks*

1. The 112-second-paragraph rejection to claim 1 and 11 is withdrawn in response to applicant's after Final amendment filed 8/12/03.
2. The double patenting rejection to claims 20 is withdrawn in response to the filing of terminal disclaimer filed 8/12/03.
3. Claims 1-4, 6-14 and 16-20 are pending in the application.

### *Allowable Subject Matter*

4. Claims 1-4, 6-14 and 16-20 are allowed.
5. The following is an examiner's statement of reasons for allowance:

The closest prior art of record, Krishnamoorthy et al. to US 6,486,533, teach a method of fabricating a semiconductor device, having a reduced-oxygen copper-zinc (Cu-Zn) alloy filled dual-inlaid interconnect structure formed on a copper (Cu) surface formed by electroplating the Cu surface in a chemical solution, comprising the steps of;

- providing a semiconductor substrate having a Cu surface 35 (i.e. a bonding layer; col.4, lines 60-64) formed in a via (Fig.1);
- providing a chemical solution (i.e. an electroplating solution);
- electroplating the Cu surface 35 in the chemical solution (i.e. an electroplating solution, col.5, lines 53-55, col. 6, lines 62-67,col.7, lines 1-42), thereby forming a Cu-Zn alloy 40 fill in the via and on the Cu surface 35 (Fig.1);
- rinsing the Cu-Zn alloy fill 40 in a solvent stored in a rinsing chamber (col.9, lines 33-37);

- drying the Cu-Zn alloy fill 40 under a gaseous flow (col.9, lines 33-44);
- annealing the Cu-Zn alloy fill 40 formed in the via and on the Cu surface 35 (col.5, line 61 through col.6, line 6), thereby forming a post-annealed Cu-Zn alloy fill having a uniform zinc distribution;
- planarizing the post-annealed Cu-Zn alloy fill and the Cu surface 35, thereby completing formation of the post-annealed Cu-Zn alloy filled dual-inlaid interconnect structure (Fig. 1); and
- completing formation of the semiconductor device.

In contrast, Krishnamoorthy et al. neither teach nor suggest that the post-annealed Cu-Zn alloy is *reduced-oxygen* Cu-Zn alloy having a *uniform zinc distribution across alloy surface and alloy thickness*; and a semiconductor device has a *first interim reduced-oxygen Cu-Zn alloy* and a *second interim reduced-oxygen Cu-Zn alloy* filled on the Cu-fill.

Therefore, the instant invention is deemed to be directed to a nonobvious improvement over the prior art of record patented in US 6,486,533. The improvement comprises forming a reduced-oxygen Cu-Zn alloy having a uniform zinc distribution across alloy surface and alloy thickness, which would improve the characteristics of a copper dual-inlaid interconnect structure.

6. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hsien-Ming Lee whose telephone number is 703-305-7341. The examiner can normally be reached on M-F (9:00 ~ 5:00).


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone number for the organization where this application or proceeding is assigned is (703) 308-7382.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Hsien-Ming Lee  
Examiner  
Art Unit 2823



Sep. 16, 2003



**W. David Coleman**  
**Primary Examiner**